
**Faculty of Mechanical and Manufacturing Engineering Technology**

# OPTIMIZATION PARAMETER OF BORON TOOL WEAR WITH SURFACE TEXTURE FOR AISI 1018 LOW CARBON STEEL IN WET TURNING PROCESS

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**Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours**

**2018**

# OPTIMIZATION PARAMETER OF BORON TOOL WEAR WITH SURFACE TEXTURE FOR AISI 1018 LOW CARBON STEEL IN WET TURNING PROCESS

**MUHAMMAD RAHDI BIN ZULKAFLI**

**This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Manufacturing Engineering Technology (Process & Technology) with Honours**

**Faculty of Mechanical and Manufacturing Engineering Technology**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2018**

# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Optimization Parameter of Boron Tool Wear with Surface Texture for AISI 1018 Low Carbon Steel in Wet Turning Process**

SESI PENGAJIAN: **2018/2019 Semester 1**

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I declare that this thesis entitled "Optimization Parameter of Boron Tool Wear with Surface Texture for AISI 1018 for Low Carbon Steel in Wet Turning Process" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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I hereby declare that I have read this report and in my opinion this report is sufficient in terms of scope and quality as a partial fulfilment for the Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours.

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## DEDICATION

Especially dedicated to my beloved father, Mr Zulkafli bin Abdul Rahman and my beloved mother, Mrs Aminah binti Yusoh who are very concern, understanding, patient, and supporting. Special thanks to my supervisor Mr Mohd Hairizal bin Osman, for the constructive guidance, encouragement and patient in fulfilling my aspiration in completing this project.

## ABSTRACT

This project was carry out to determine the significant factor of parameter that influence the boron tool wear based on the surface texture design. The machining process was performed on the CNC turning machine by using the boron cutting tool insert with surface texture and the material that use is AISI 1018 low carbon steel. Besides that, the aim of this project is to optimize the parameter of boron cutting tool wear insert by utilizing the Taguchi method. The selection of parameter are surface texture, feed rate and spindle speed. The type of surface texture are perpendicular, eclipse and wavy. Then, value of feed rate that selecting are 0.04mm/ min, 0.06 mm/min and 0.08 mm/min. Besides that, the spindle speed are 400 rpm, 450 rpm, and 500 rpm. The experimental design by using L9 orthogonal array with 3 level and 3 factor. The experiment was conduct which three trial. The data was obtain by using SMZ 745T Optical Microscope. The Minitab software was use to analyses the data that get based on Taguchi design.

## ABSTRAK

*Projek ini dijalankan untuk menentukan faktor parameter penting yang mempengaruhi Kehausan mata alat Boron berdasarkan reka bentuk tekstur permukaan. Proses pemesinan dilakukan menggunakan mesin CNC larik dan pada mesin tersebut mata alat Boron dengan tekstur permukaan digunakan dan bahan yang digunakan untuk melarik adalah keluli karbon rendah AISI 1018. Di samping itu, tujuan projek ini adalah untuk optimumkan parameter kehausan mata alat Boron dengan menggunakan kaedah Taguchi. Pemilihan parameter adalah tekstur permukaan, kadar suapan dan kelajuan gelendong. Jenis tekstur permukaan adalah tegak lurus, gerhana dan ikal. Kemudian nilai kadar suapan yang dipilih ialah 0.04 mm/ min, 0.06 mm / min dan 0.08 mm / min. Selain itu, kejauan gelendong adalah 400 rpm, 450 rpm dan 500 rpm. Reka bentuk eksperimen ini menggunakan array ortogonal L9 dengan 3 tahap dan 3 faktor. Tiga percubaan dijalankan bagi setiap eksperimen. Data diperoleh dengan menggunakan Mikroskop Optik SMZ 745T. Perisian Minitab digunakan untuk menganalisis data yang berdasarkan Reka bentuk Taguchi*

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## ACKNOWLEDGMENTS

Alhamdulillah, Praise to God for His help and guidance that I am able to complete the task of this Bachelor Degree Project. I am thankful and grateful to my supervisor, Mr. Mohd Hairizal bin Osman for his advice and knowledge that he shared in the completion of the project. I am appreciate his help to me while I am doing the Bachelor Degree Project until I am finish it. Not to forget to Mr. Mohamad Ridzuan bin Mohamad Kamal, Mr. Muhammad Syafik bin Jumali and all the assistant engineers which are Mr. Azizul Ikhwan bin Mohd, Mr. Basri bin Bidin and Mr. Norhisyam bin Abdul Malik for give a lot of guidance and new knowledge to me during doing this Bachelor Project.

I also would like to thank all my friends who have been really helpful during the course of the conducting the Bachelor Degree Project. With a little help of ideas from them, I can complete this report.

I sincerely grateful to my parents for their love and their support for me throughout my life in all my activities that I have done. I also wanted to thank other people who have directly or indirectly help in the completion of my Bachelor Project. I sincerely appreciate all your help.

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## LIST OF SYMBOLS

| | | |
|---|---|---|
| AISI | - | American Iron and Steel Institute |
| ANOVA | - | Analysis of Variance |
| CNC | - | Computer Numeric Control |
| GPa | - | Giga pascal |
| HSS | - | High Speed Steel |
| mm | - | Millimeter |
| LST | - | Laser Surface Technology |
| kg | - | Kilogram |
| NC | - | Numerical Control |
| Mn | - | Manganese |
| MPa | - | Mega pascal |
| PA | - | Parallel to cutting edge |
| PE | - | Perpendicular to cutting edge |
| µin | - | Micro inches |
| µm | - | Micro meter |

# CHAPTER 1

# INTRODUCTION

## 1.0 Introduction

The chapter one will be explain about the introduction of this project. It consists of the project background, problem statement, objective, and work scope.

## 1.1 Project Background

In this modern age, there are many challenges in the manufacturing industry. The quality of the machined parts and increase the productivity are the examples of the main challenges in this industry. The lot of researches have been conduct, in order to identify the difference method for optimise the machining parameter which significant with the machining process optimization during the turning machining operation. (Bharilya, Malgaya, Patidar, Gurjar, & Jha, 2015).

Metal cutting is one of the most important manufacturing processes, That is because parts manufactured by casting, forming and various other shaping processes often require a further metal cutting operation before the product is ready for use. In metal cutting, a cutting tool is used to remove excess material from a work piece in order to convert the remaining material into the desired part shape .Proper selection of tool materials, cutting parameters, tool geometry and machine tools is essential to produce high-quality products at low cost. Therefore, many attempts have been made to reduce cost and improve quality through the understanding of the cutting process.

The Taguchi experimental design method is a well- known, unique and powerful technique for product/process quality improvement. It is widely used for analysis of experiment and product or process optimization. (Madhavi, Sreeramulu, & Venkatesh, 2017). This project will come out with the optimization of the parameter of the tool wear based on the surface texture consider with the parameter of CNC turning machine.

## 1.2 Problem Statement

In recent decades, efforts to increase productivity and minimise costs in machining processes have been important aspects. Higher material removal rates and better product qualities have been obtained by using new cutting tools. New cutting tools have greatly been improved machining of several engineering materials, even in some case of difficult-to-cut metals. There are still some problems in machining processes; one of them is the occurrence of high temperature in cutting zone. The rising of temperature during cutting processes negatively affects tool life. It also adversely changes machine parts quality, such as dimensional accuracy and surface quality.

During machining, the chip flows over the rake face of the tool with high velocity leading to intimate contact between the chip and tool which results in high normal pressure and temperature at the contact region. As a result, severe friction occurs and the tool wear mechanisms such as abrasive, adhesion and chemical dis- solution are triggered. The tool wear affects the surface integrity of the work piece and the cutting performance of the tool. Therefore, it is essential to improve the tribology at the tool-chip interface. (Vasumathy & Meena, 2017).

## 1.3 Objective

The objectives of this project are:

- To determine the significant factor of parameter that influence the boron tool flank wear based on the surface texture design.
- To identify the optimum parameter of boron tool flank wear with surface texture in wet turning machining process on AISI 1018 Low Carbon Steel.

## 1.4 Work Scope

i. Three types of surface texture on the boron cutting tool insert that used in this project are perpendicular, wavy and eclipse.

ii. Machining process will be conduct by using Computer Numerical Control (CNC) turning machine.

iii. The machining run in wet condition. So, the cutting fluid will be used during turning machining operation.

iv. Material that be used is AISI 1018 low carbon steel rod.

v. Layout Design using $L_9$ Orthogonal Array and ANOVA (Analysis of Variance).

vi. The engraving surface texture design will be engraving by CNC laser machine.

vii. The Flank wear will be analysis by using the optical microscope.

# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Introduction

The chapter two will be some discussion about the research background related to the project. This chapter also discuss about the journals were make as references and good example from other sources that related with project.

## 2.1 Turning

The turning process is the process that reducing the external diameter of cylindrical part and it the process of machining to manufacture the cylindrical work piece. The decreasing of the diameter work piece by using turning commonly into specified size and in order to produce a good surface finish product. Turning process regularly the work piece should be rotate in order to close segment have dissimilar diameter. Fundamentally, it can describe as the machining process of the outer surface part and the motion rotating involve in this process by using the cutting tool feeding into the work piece at the specific feeding distance. Figure 2.1 shows the fundamental of turning process to produce the cylindrical part. (Butola, Jitendrakumar, Vaibhavkhanna, Ali, & Khanna, 2017).

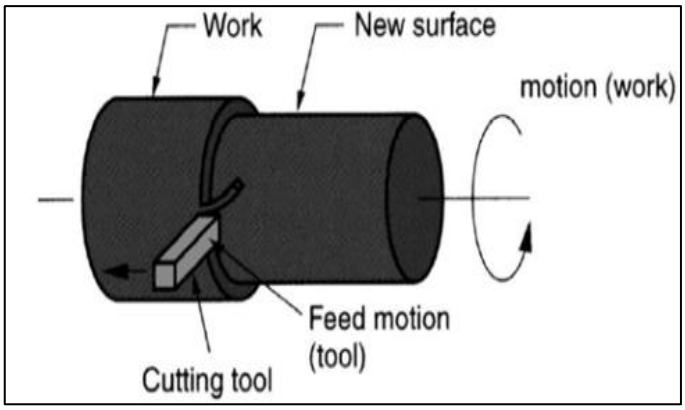


Figure 2. 1: Fundamental of Turning Process to Produce the Cylindrical Part

Turning is a shaping process of material by remove the outer surface and it is a form of machining. Turning process need a turning machine, work piece, fixture, and cutting tool to shape the material by reducing the outer diameter. To allow the work piece rotate at high speed the work piece is connected to the rotating fixture or device of the turning machine. In order to create the desired shape the cutting tool feed toward to the rotating work piece with parallel motion and remove the outer diameter of material in the form of chip. The improvement of thetribology properties and fatigue strength of the material need increase in order to get the good surface finish. The value of surface roughness is bigger influence by feed rate of parameter turning machining. The spindle speed parameter is the moderate factor that influence surface roughness. While, the depth of cut not affect the surface roughness. (Madhavi et al., 2017).

### 2.1.1 Turning Machine

The turning machines are almost same with lathes. In term of manufacturing, the lathes can be categorized by engine, turret, automatics, and numerical control. The machine is capability to handle the tool movement and heavy duty machine tools. The common of the range size of this machine are 24 to 48 inches from the centre distance and 12 to 24 inches

from the side. Mostly the turning machine or lathes machine are provided with coolant circulating system and chip pans. (Butola et al., 2017).

### 2.1.2 CNC Turning Machine

The machining process is machine control by using Computer Numerical Control (CNC) technology. Through CNC machine, it can produce the high quality machining components part and the superior material removal rates can be obtained. Generally, CNC turning machine is operating by certain parameter such as spindle speed, feed rate and depth of cut. (Gowd, Goud, Theja, & Reddy, 2014).

The CNC turning machine is completely automated and intelligent machining process. The machine is automatic determine the cutting state based on the parameter machining require and an estimate it by neglect any cutting condition. With this situation it complimentary to study the methodology in order to identify state of machining cutting. (Tangjitsitcharoen & Moriwaki, 2008).

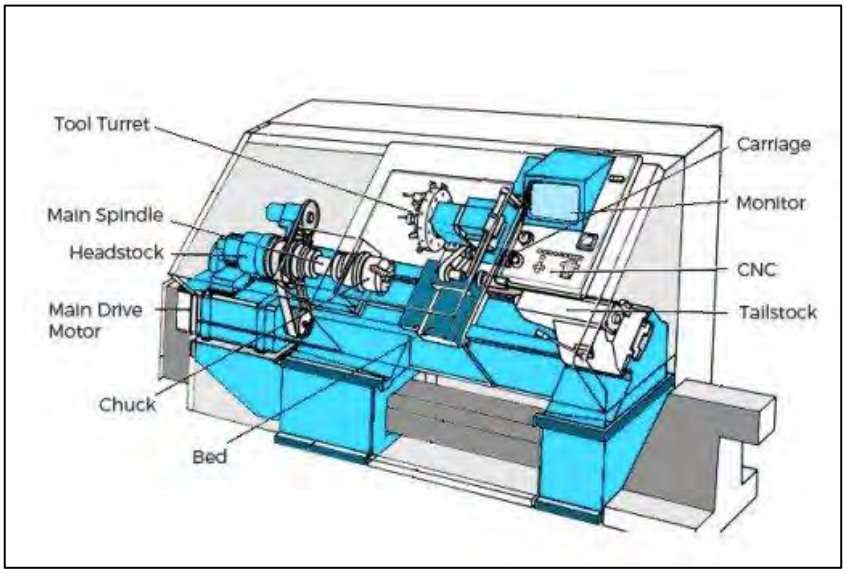


Figure 2. 2: Main Part of CNC Turning Machine